PHILIPS OPTICAL STORAGE

USER MANUAL

PREMIUM 10502

"CD-Pro2M"

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Preface

This document gives some application information on how to use the Premium 10502 application. The Premium 10502 is intended for use in high-end and professional audio/video applications. Using the kit and documentation should make it possible to provide a quickly start of the design-in work.

The Premium 10502 is a complete functional module that consists of the CD engine, cables and documentation. The CD engine is equipped with a PCB underneath the mechanism. The PCB contains the electronics and provides the necessary interface to connect the unit to the external application circuit.
The unit can be controlled through the so-called DSA bus. Available DSA commands are described in the Premium 10502 documentation. The DSA control software, which runs on an IBM compatible PC, is available upon request.

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PREMIUM 10502

"CD-Pro2M"

Keywords:
High-end Audio
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VAU1254
Premium 10502
CD-Pro

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Revision history

Version	Date	Remarks
Version 0.2	30 Jun 2003	Draft version
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1. Introduction

The Premium 10502 module offers a high performance CD-engine, which is designed to deliver an excellent playability and very low mechanical playing noise.
The module provides high-quality audio output signals. For those customers who strive for extreme high performance audio, fine-tuning the analogue audio output with additional post filtering can be used. Using a special external DAC is still possible as the digital I2S signals are available.
Refer for all technical specifications to the data sheets only.

1.1 Abbreviations used

CD	Compact Disc
CD-DA	Compact Disc Digital Audio
CD10	SAA7324 Compact Disc Decoder & Digital Servo
DAC	Digital to Analogue Converter
DSA	Data Strobe Acknowledge (communication interface)
EBU	European Broadcasting Union
HF	High frequency (EFM) signal
LDGU	Laser Detector and Grating Unit
PCB	Printed Circuit Board
QFP	Quad Flat Pack
VAM	Video Audio Module (CD Mechanism)
VAU	Video Audio Unit (Assembly of VAM and PCB)

2. System overview

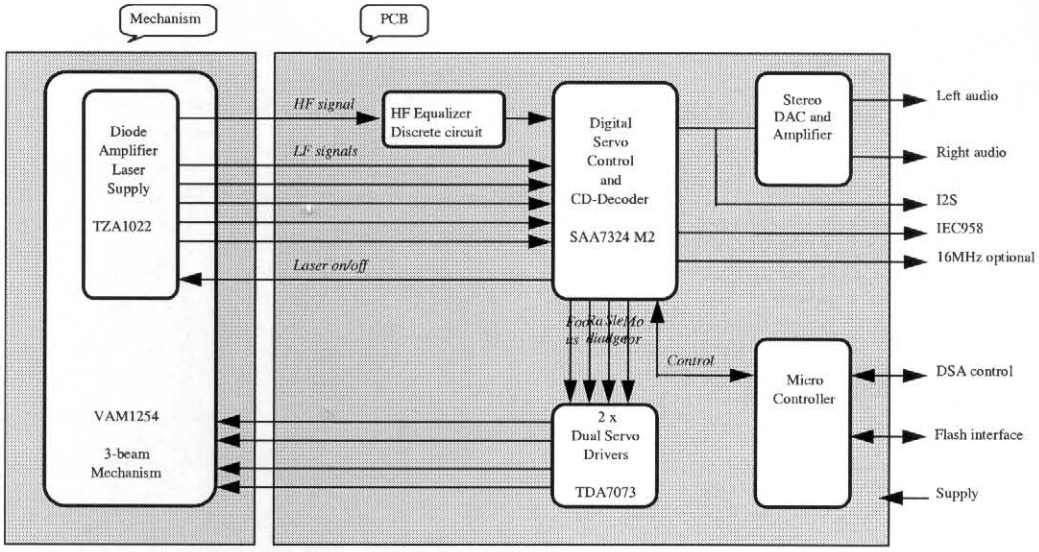

Figure 1: Block diagram

The left part of this diagram shows the VAM1254 CD-mechanism. The total assembly of VAM1254 and the application PCB is called the CD Engine.

Features

- The 8-bit pre-programmed micro controller provides the following functions (summary):
  Execute DSA commands towards the VAM1254 mechanism and CD10 decoder.
  Return sub code and status information to external controller via DSA bus.
  Send sledge home at power up.
  Flash new software into micro controller
- The mechanism VAM1254 is a three-beam mechanism with single Foucault focus error detection and LDGU (Laser Detector Grating Unit) holographic pick-up.
- Special S(ilent) version of digital servo controller with automatic adjustments to fine-tune the application - no manual re-adjustments needed.
- On board high performance Delta-Sigma DAC with analogue stereo line-output.
- Digital EBU output.
- I2S output for connection to external DAC or MPEG decoder
- Optional 16 MHz clock output
- Double (+5 and +9 V) power supply operation
- Memory Re-flash feature at 5V power supply only

2.1 Some numbers

Software version:	Version 6.x
Software ROM size:	About 32k bytes.
Laser power:	375 µW.
HF signal amplitude:	I11 about 1.0 V pp (measured at HFIN)
Focus bandwidth:	1000 Hz.
Radial bandwidth:	1200 Hz.
Audio output level:	1.5Veff
Audio output impedance:	110 ohm

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3. PCB key component and connector placement

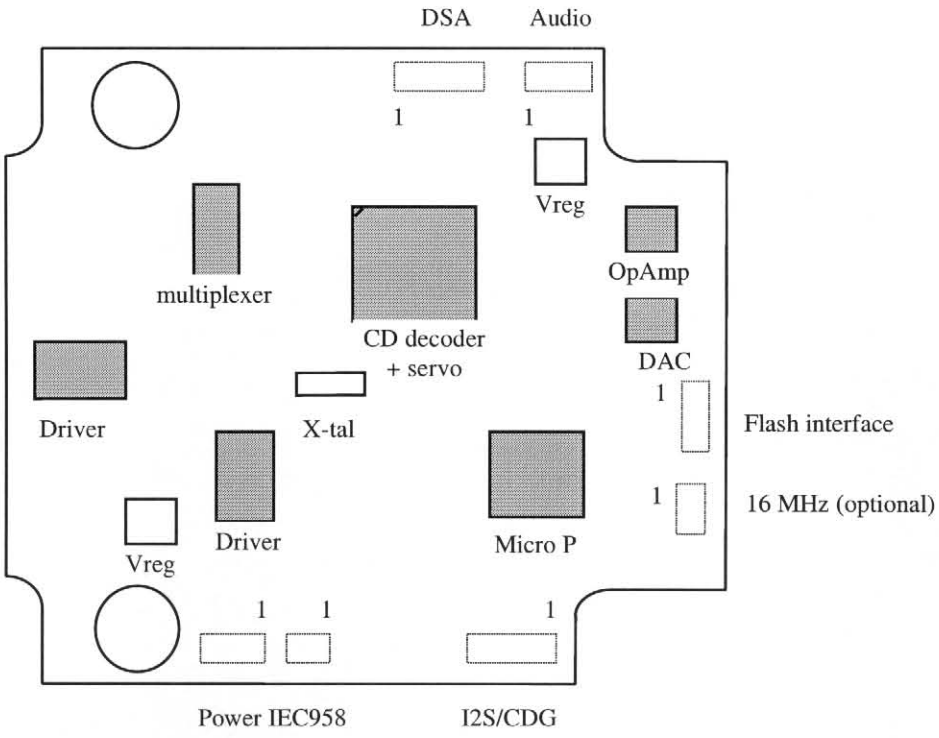

Figure 2: PCB component view

4. Configuration option

The PCB is prepared for the following option:

Option	Function
16MHz output	Connector X1008 is not mounted by factory default Connector can be mounted if 16 MHz is needed e.g. in case of Video applications

5. PCB connector interface description

5.1 The actuator connector (internal connection)

The 6-pole actuator connector is a Molex type 52207-0690 series connector.

PIN	Function	I/O	Description
1	SL+	O	Control signal for sledge motor
2	SL-	O	Control signal for sledge motor
3	Home switch	I	Home switch input
4	GND		Ground for home switch
5	M-	O	Control signal for disc motor
6	M+	O	Control signal for disc motor

Table 1: Actuator connector pinning

The signals SL+ and SL- form the connections to the sledge motor. The signals M+ and M- form the connections to the turntable motor. The home switch gives the microprocessor information whether the sledge is moved completely to the inner side. The "GND" supplies the other end of the home switch, but as well functions as grounding wire for the ornamental plate.

5.2 The diode flex connector (internal connection)

The 16-pole flex connector is a Molex type 52207-1690 connector.

PIN	Function	I/O	Description
1	Vsub	P	+5V substrate for detector diodes
2	GND	P	LDGU ground
3	VDD	P	Supply voltage for pre-amplifier
4	RF	-	Not equalised HF signal
5	LDON	O	Laser on/off control H=laser on, L=laser off
6	R2	I	Signal from detector diode (satellite diode)
7	R1	I	Signal from detector diode (satellite diode)
8	B3	I	Signal from detector diode (central hf diode)
9	B2	I	Signal from detector diode (central hf/focus diode)
10	B1	I	Signal from detector diode (central hf/focus diode)
11	FTC	I	NOT USED
12	RW	O	Control of CD-DA and CD-RW
13	FOC+	O	Control signal for focus actuator
14	FOC-	O	Control signal for focus actuator
15	RAD+	O	Control signal for radial actuator
16	RAD-	O	Control signal for radial actuator

Table 2: Flex connector pinning

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5.3 The DSA connector

The 6-pole DSA connector is a JST PH series connector.

PIN	Function	I/O	Description
1	ACK	I/O	Acknowledge
2	DDA	I/O	Data
3	DST	I/O	Strobe
4	DRST	I	Reset
5	GND	O	Ground
6	LASER-OFF!	I	Control input for laser H=laser ON, L=laser OFF

Table 3: DSA connector pinning

When controlling the Premium 10502 with an external PC, the reset line is unused.
Note that when the reset line is pulled high, this will reset the servo processor. CAUTION: Do not connect the external reset line to ground directly. This will prevent the microprocessor from being reset properly at power-up!
The 6th pin is added for laser safety requirements. The user can connect this pin to a "door switch" such that whenever a user opens the lid of the cabinet, this will switch off the laser power. A "low" on this pin will switch off the laser power. When not connecting this pin, it will float high. It is recommended when using long external wiring to the LASER_OFF pin to put a small 100 nF capacitor over the LASER_OFF input to prevent noisy glitches while switching-off the module.

The mating (female) connector is an assembly of a JST type PHR-6 housing with 6 contacts type SPH-002T-P0.5S. Recommended wire is type AWG24.

5.4 The I2S/graphics connector

The I2S/Graphics connector is a JST PH series connector. This is a 6-pole connector.

PIN	Function	I/O	Description
1	MISC	O	C2 error flag
2	SCLK	O	Serial clock
3	WCLK	O	Word clock (word select)
4	DATA	O	Data
5	GND	O	Ground
6	V4 (serial CDG output)	O	Serial CD Graphics output

Table 4: Connector pinning

When using the engine as a standard CD-DA module, without the MPEG option, an external DAC PCB may be connected to this connector. This external DAC will only use the WCLK, SCLK, DATA and ground lines of this connector. Note that for this application, the module has to be programmed for audio DAC mode via the DSA interface. Data will come out via the I2S connector in the I2S (default) or EIAJ (programmable via DSA command) format.

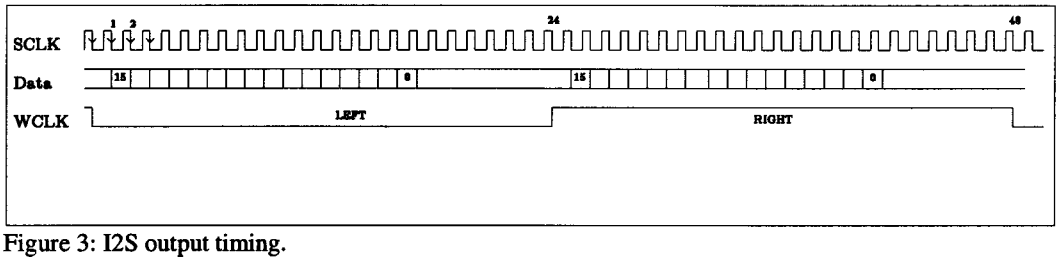

Figure 3: I2S output timing.

Remark: The I2S output timing depends on the settings by software; see DSA commands.

The MISC/error pin is a multi-purpose pin. When the module is in "audio mode", this pin will supply a clock at double the speed of the WCLK clock. In CD-ROM mode however, this "MISC/error" pin will

signal uncorrectables to the MPEG board. A logic "1" means that data output by the data interface is incorrect. A logic "0" means data is OK.

Also an external CD-graphics decoder may be connected to this interface for karaoke applications. The external CD-G decoder uses both the I2S signals as well as the V4 connector pin. The V4 pin provides the QRSTUVW (Q-W channel) sub code flags in a serial way. The R-W flags can be used by the CD-G decoder. A group of 96*6 bits forms one CD-G block.
The MISC pin is, or can be, used when the output of the Premium 10502 should be connected to a CD-ROM decoder or MPEG decoder. For audio applications this pin is not used.

The mating (female) connector is an assembly of a JST type PHR-6 housing with 6 contacts type SPH-002T-P0.5S. Recommended wire is type AWG24.

5.5 The EBU connector

The EBU connector is a JST PH series connector. This is a 2-pole connector.

PIN	Function	I/O	Description
1	Dig-GND	O	Ground
2	EBU dig data (IEC958)	O	EBU output according IEC958 standard

Table 5: EBU connector pinning

Equipment using an EBU interface, or measurement equipment may be connected to this interface. This interface uses an unbalanced line (two-wire transmission) as described in the IEC-standard. The interconnecting cable should be screened and should have a characteristic impedance of 75 at 2.8224 MHz.

The signal amplitude should be 0.5V +/-20% peak-to-peak, when measured across a 75-ohm resistor connected to the output terminal, without any interconnecting cable present. Rise and fall times are in the order of 10 ns (under the same conditions).

The mating (female) connector is an assembly of a JST type PHR-2 housing with 2 contacts type SPH-002T-P0.5S.

5.6 The power connector

The 4-pole power connector is a JST PH series connector.

PIN	Function	I/O	Description
1	GND	I	Ground pin 9V (not connected on PCB to ground pin 5V)!
2	+9 V supply	I	9 volt supply for motor and actuator drivers TDA7073
3	GND	I	Ground pin 5V (not connected on PCB to ground pin 9V)!
4	+ 5 V supply	I	5 volt supply

Table 6: Power connector pinning

Pin 1 and 2 function as a supply for the actuator drivers (+9V). Pin 3 and 4 supply the rest of the circuitry (+5V). The GND signals are not connected on the PCB itself but must be connected at the power supply to prevent unwanted disturbance signals.

The mating (female) connector is an assembly of a JST type PHR-4 housing with 4 contacts type SPH-002T-P0.5S. Recommended wire is type AWG24.

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5.7 The Audio (line-out) connector

The 4-pole line-out connector is a JST PH series connector.

PIN	Function	I/O	Description
1	Right audio	O	Analogue audio output right channel
2	A-GND	O	Ground
3	A-GND	O	Ground
4	Left audio	O	Analogue audio output left channel

Table 7: Line-out connector pinning

The mating (female) connector is an assembly of a JST type PHR-4 housing with 4 contacts type SPH-002T-P0.5S. Recommended wire is type AWG24.

5.8 The 16 MHz clock output

The 3-pole clock output connector is a JST PH series connector. This connector is optional and not stuffed on the PCB.

PIN	Function	I/O	Description
1	Dig-GND	O	Ground
2	CLK16	O	16.9344 MHz clock output
3	Dig-GND	O	Ground

Table 8: Clock-out connector pinning

This clock output provides a 16.9344 MHz clock that can be used by MPEG boards, which require a clock synchronous with the CD decoder.

5.9 Flash interface

The 5-pole flash interface connector is a JST PH series connector.

PIN	Function	I/O	Description
1	+5 V	I	Power supply for programming
2	PSEN	I	Program Store Enable signal
3	RXD	I	Receiver line in serial port
4	TXD	O	Transmitter line in serial port
5	GND	I	Ground
6	Reset	O	Power On Reset Pulse to Microprocessor

Table 8: Flash interface connector pinning

The flash interface enables re-programming of the system firmware by electrical connection and software control. For this the optional flash interface board should be used, together with an In-System Programmer. See relevant chapter of the Premium 10502 documentation.

The mating (female) connector is an assembly of a JST type PHR-6 housing with 6 contacts type SPH-002T-P0.5S. Recommended wire is type AWG24.

6. The DSA control interface

The DSA (Data Strobe Acknowledge) interface is a serial interface used for communication between 2 processors. One of these is located on the CD engine PCB; the other one is an external processor on another PCB (CD-player) or a PC computer. In this paper we call the external processor the "host". Communication between host and CD engine uses a 16-bit structure. The 16 bits contain a COMMAND byte followed by a DATA byte, transmitted in one string. Transmission is done with the MSB first. Both processors can send commands to the other. For example the host can send Start or Stop commands; the CD-engine can send time information to the host.

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6.1 DSA interface bus protocol

Each data communication consists of three phases:

- Synchronisation phase.
- Data transmission.
- Acknowledge phase.

A full description of the protocol is documented in a separate manual in the premium 10502 starter kit documentation.

6.2 DSA Commands

The commands understood by the servo processor on the CD engine are documented in a separate manual in the Premium 10502 DSA documentation. The table in next chapter gives a summary of permitted commands and responses.

The servo processor on the CD engine does not only receive commands, it will give back information as well. The information to be output by the servo processor can be programmed by putting the servo processor in a different mode. For instance, there is a mode, such that the servo processor gives no information back at all, or another mode, where the processor gives back subcode information, and so on. Attached at the end of this document, some examples are given.

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6.3 Summary of DSA Control commands

The commands are divided into the following groups:

- Control commands
- Info retrieve commands
- Mode setting commands
- Service commands

A full description of the commands is given in the relevant chapter of the Premium 10502 starter kit documentation.

Command name	Function
Play title	Play title number nn and respond with specified info according Set Mode
Stop	Stop playing, sledge move to the home position, disc is stopped
Read TOC	Reads the TOC of the specified session and sends info to the user processor
Read long TOC	Reads the complete TOC and sends info to user processor
Clear TOC	Clear the TOC stored in RAM
Pause	Stop playing the disc, present sledge position is maintained
Pause release	Continue playing the disc at present sledge position
Goto time	Jump to the absolute requested time location on disc and respond with found
Spin up	Spin up the disc at the specified session and respond with found
Play A till B time	Play from absolute requested time A till absolute time B

Summary Info retrieve commands

Command name	Function
Get tittle length	Send the time of the specified title to the user processor
Get complete time	Send the absolute disc time to the user processor
Get last error	Send the last encountered error to the user processor
Get disc status	Send the current disc status
Get session info	Send the number of finalised sessions on the disc

Summary of Mode setting commands

Command name	Function
Set Mode	Mode setting for speed, TOC info, and activates the AUDIO or ROM mode
Clear error	Clear the latest error code
Release A->B time	Releases the A till B time feature
Set volume	Set the volume level (only in audio mode) from 0 till 255 (full scale)
Set DAC mode	Set I2S output format and error correction for AUDIO

Summary of Service commands

Command name	Function
Service mode on	Switches the service mode on and gives the servo version number
Service mode off	Switches the service mode off and gives the servo version number
Sledge jump	Make a sledge jump of 300 ms
Sledge off	Switches the sledge movement off and go to the inner position
Focus on	Switches the focus on
Focus off	Switches the focus off
Turntable motor on	Switches the turntable motor on
Turntable motor off	Switches the turntable motor off
Radial on	Switches the radial control loop on
Radial off	Switches the radial control loop off
Laser on	Switches the laser on
Laser off	Switched the laser off

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7. Micro Controller pinning

Remark:
Micro controller pinning given in this chapter, is for information only and can be used in case of debugging. No guarantee can be given that NC (Non Connected) pins will not be assigned in future software versions.

7.1 General

The micro controller is specially designed for the high-end CD engine, to control the mechanism and CD10, and is based on the generic P89C51xxx CMOS single-chip micro controller with internal re-flashable ROM.

Device name: P89C51RC2BBD
Function: High-end Audio and Video CD applications with VAM1254 and CD10
Package: 44 pin QFP

7.2 Features

- Controls the CD10 decoder/servo IC
- Translates between high level DSA commands to low level CD-player commands
- Provides subcode/time information and player status information
- Uses the DSA bus protocol as communication interface to an external processor
- Can be re-programmed (re-flashed) with new system software

7.3 Micro controller Pinning

Micro controller (P89C51RC2BBD) Package: QFP44				
Pin	**Name**		**I/O**	**Function**
1	P1.5	DSA-DATA	I/O	DSA data
2	P1.6	DSA-STR	I/O	DSA strobe
3	P1.7		NC	
4	RST	DSA-RST	I	HIGH: Microcontroller is in reset mode
5	P3.0/RxD	RXD	I	Serial port receiver
6			NC1	
7	P3.1 /TxD	TXD	O	Serial port transmitter
8	P3.2/INT0!	Laser on	O	Laser power on-off control HIGH = laser on, LOW = laser off
9	P3.3/INT1!		NC	
10	P3.4		NC	
11	P3.5		NC	
12	P3.6		NC	
13	P3.7		NC	
14	XTAL2		O	Crystal Oscillator.
15	XTAL1		I	Crystal Oscillator (12 MHz)
16	GND		-	Ground
17			NC2	
18	P2.0	DMSB	O	Audio enable of double speed input for DAC
19	P2.1		NC	
20	P2.2		NC	
21	P2.3	RW	NC	Control of CD-DA and CD-RW
22	P2.4	HOMESW!	I	LOW: Sledge of VAM1254 mechanism is in home position
23	P2.5		NC	
24	P2.6		NC	
25	P2.7	+9V Drop	I	+9V Drop (Power Off) Detection
27	ALE/PROG!		NC	Address Latch Enable.

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				This micro controller does not use any external RAM or ROM. This pin should be left unconnected.
28			NC3	
29	EA!/Vpp		I	Not External Address. This pin should be held high to ensure that the microcontroller uses internal program memory only. +12V during flash.
30	P0.7/AD7	S2	O	Switching control for equaliser & filter
31	P0.6/AD6	S1	O	Switching control for equaliser & filter
32	P0.5/AD5		NC	
33	P0.4/AD4	Reset	O	Reset for CD10 SAA7324
34	P0.3/AD3	Mute	O	Mute signal for DAC
35	P0.2/AD2	On_track	O	Factory design
36	P0.1/AD1	HW_Mute	O	Hardware Audio Mute Control
37	P0.0/AD0	HFDET	I	HF detector
38	VCC		-	+5V supply
39			NC4	
40	P1.0	DSA-ACK	I/O	DSA acknowledgement
41	P1.1		NC	
42	P1.2	SDA	I/O	Serial data for communication with CD10
43	P1.3	SILD	O	R/W control and data strobe to CD10
44	P1.4	SCL	O	Serial bit clock for communication to CD10

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8. Power requirements

The CD Engine PCB requires 2 external power supplies. This section shows the required supply levels and currents.

	Stop mode	Spin up/down & jump	Normal play
+5V	120 mA	180 mA	190 mA
+9V	40 mA	600 mA	120 mA

Table 10: Power requirements

The peak current of 600 mA for the +9V supply will be during spin up or down of the disc. This will take about 1-2 seconds, and then the power consumption will drop to the average normal play value.

8.1 Switching the power on /off

Between switching off the power of the module and switching it back on again, the user should wait 1 sec. (Just like in any other audio application). This to make sure that the microprocessor is properly reset during power up. The max. RESET TIME is 1 sec. after the 5 V and 9 V supplies have been switched on. After this time, commands (e.g. SPIN_UP) may be sent. If the sledge is - on this moment - not yet at the inner position, the command will be executed on the moment the sledge is home!

If the user wants to avoid improper reset of the microprocessor on successive power-on/power-off cycling without waits, an external reset pulse can be given to the microprocessor via the DSA interface, to guarantee that the microprocessor is reset.

8.2 Rise time of the power supplies

It is recommended at start-up to switch on the +5V supply first, followed by the +9V. A delay of 150 msec is enough here, increasing this figure is not necessary for normal supplies. Only when the rise time of the +5V is very slow, this time has to be increased. When +5V is present, the system generates an internal reset to put the circuits into the defined starting position. To deal with slow rising of the +9V, the internal reset is repeated as soon as the +9V is present. The +9V must be present within about 2 sec after +5V otherwise the audio remains muted.
If the +9V power comes up faster than the +5V, the user may notice spurious movements of the actuator or the sledge upon power up.
If the +5V and +9V have the same rise time, the actuator movement is reasonable.

It is recommended to switch off the power supply in reverse order: +9V first, followed by the +5V. When switching the power on or off a click noise may be audible through the audio output. When using amplifiers with proper speaker protection during power up/down, this will cause no trouble.

8.3 Ventilation

The +9 V terminal can be connected to a power supply level between 8.1 and 10.35V. It is possible to operate it with higher supply levels, but this extra power will only be translated into extra heat which in turn will decrease the lifetime of the product, so it is recommended to operate it at supply levels between 8.1 and 10.35V. When operating the CD engine inside a closed cabinet on supply levels higher then 10.35V, the temperature of the module will substantially rise, thus warming up the laser. This will reduce the lifetime of the module. Therefore, when using higher supply levels, it is recommended to provide some ventilation holes (or a fan) inside the cabinet in the neighbourhood of the two TDA7073AT drivers. These two IC's can get very hot during operation, especially during spin up or down and track searching.

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9. Getting the best audio performance

The usual audio software on CD-DA discs has a SNR of 98dB max. The audio output is already de-emphasised, and then quantisized to 16 bits again. This means at this stage, the theoretical maximum attainable SNR from the DAC will be 98dB. Measured operational values are about 97dB. THD at 0dB input signal will be -85dB, at -60dB input signal will be -35 dB.

For the best audio performance, the power supply wires should be type AWG24 wire. The PCB should be connected to 2 independent power supplies. One for the +5V, the other for the +9V. The ground terminals of the two power supplies must be connected at the supply side to reduce voltage drop or ripple over the power wiring. The ground terminals of the supply connector are not connected on the PCB itself!!!

9.1 Absolute audio phase

One of the properties of the DAC is that the phase of the audio output has turned 180 degrees. For those customers who want to feature absolute phase in their design, an inverting amplifier should be used between the Premium 10502 module and speaker/headphone output.

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10. Connecting the Premium 10502

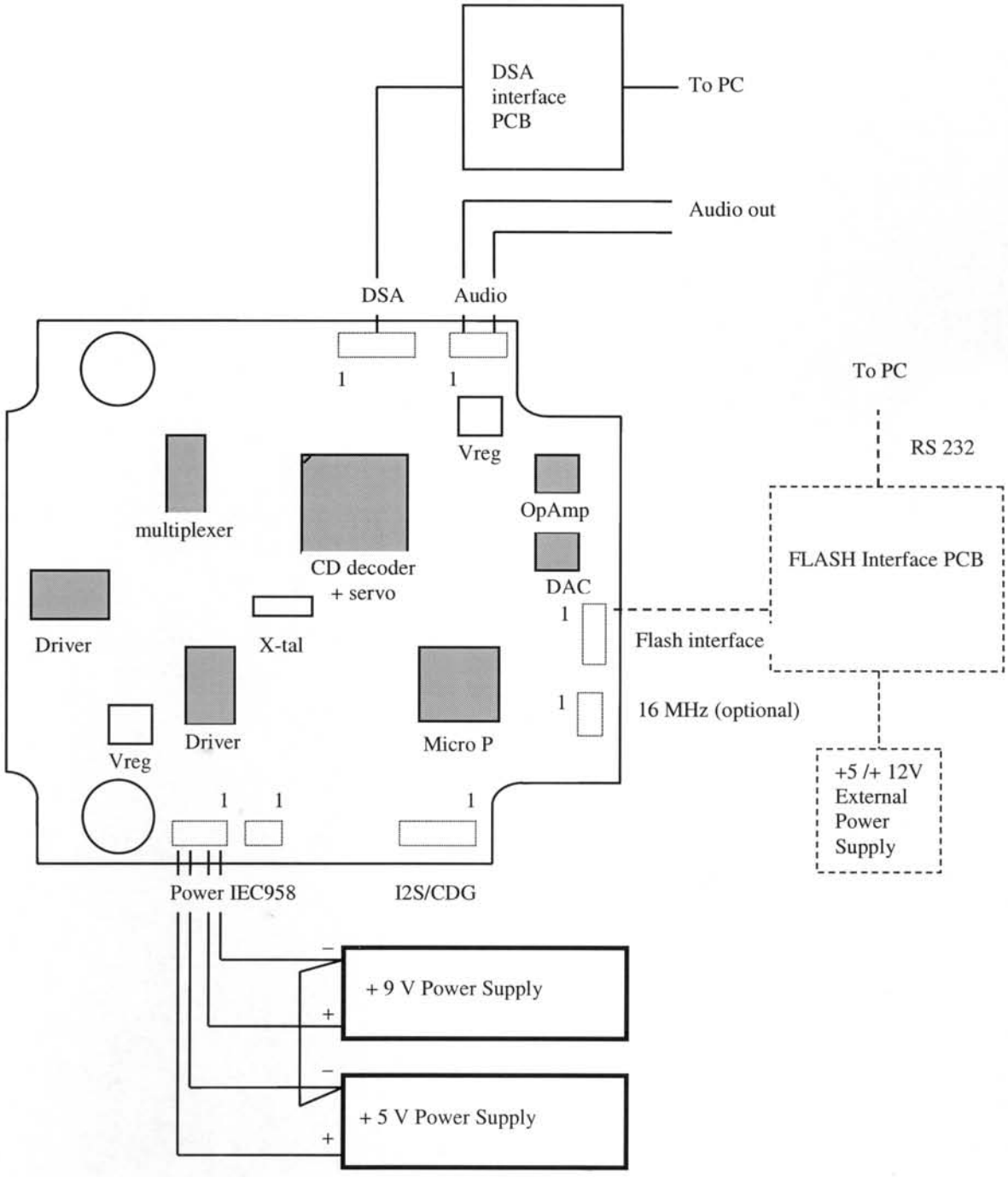

Figure 4: Connecting the Premium 10502.

Remark:
The grounds (-) of the +5V and +9V must be interconnected at the power supply side. These grounds are not interconnected at the PCB side!!

11. Problem solving.

Some tips on trouble shooting the Premium 10502, when the set does not work correctly.

- At start-up the sledge does not move home, but the actuator starts ramping.
  Probably the servo microprocessor is not running. Check microprocessor oscillator.

- At start-up, the sledge moves wildly in both directions.
  Home switch short circuit to ground.

- Set gets into focus, but does not start spindle motor.
  Check pin 26 of CD10. If there's a clock, there must be something wrong in the spindle motor driver stage. If there is no clock at pin 26 of CD10, check the oscillator crystal circuit of CD10.

- At start-up the sledge moves home and then starts rattling.
  The home switch wiring probably interrupted or dirty contacts of home switch.

- At start-up the sledge moves home, then the set does not do anything at all.
  Probably something wrong with the DSA wiring.

- CDM does not ramp to catch focus. Software gives message "FOCUS ERROR/ NO DISC".
  Check voltage across the safety resistor 3208

12. General application information

Valid for high-end and professional CD audio applications.

Operational speed:
- Speed n =1
- Speed n = 2 (optional), design is functionally prepared to run on double speed, but not released.

Position of operation:
- Horizontal is recommended
- Vertical is allowed with preferred side A or B down, see VAM1254 data sheet

Safety:
- Special measures have been taken for safety reasons:
  1. A laser off input is implemented
  2. Safety resistors (NFR) have been applied

The Set maker is responsible for safety of the total application including the CD engine used in this application

Radiation:
Not valid, to be specified by the set maker
Although the set maker is responsible, measures have been taken to reduce radiation by using double sided PCB and SMD technology.

Shielding:
If a metal shielding is used with a distance of less then 5 mm to the PCB, the shielding has to be connected to the PCB ground.

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